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(54) Title: CONTROL OF REMOTE DEVICES USING HTTP PROTOCOL

(57) Abstract

Control of remote devices is achieved by having httpd (Web server) on a dedicated firmware device. A firmware device with a httpd (Web server) programmed into its memory takes commands from a remote http client (Web client). The firmware sends interface information to the target device with electronic, electromagnetic, or infrared signals to control the target device. The firmware may be integrated into an IC chip so product makers can have the same remote control capability within their product.

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Title

CONTROL OF REMOTE DEVICES USING HTTP PROTOCOL

Field of the Invention

This invention relates to methods and means for control of remote devices at remote locations via the internet preferably using an http protocol, and particularly to World Wide Web servers (httpd) (http demons) for Ethernet networks.

Background of the Invention

The World Wide Web (www) has become extremely popular on the Internet as a method of broadcasting information to the world. In the Sun-World 95 conference, held in San Francisco, California on May 22 to May 25, 1995, Sun Microsystems' introduced its Internet firewall. Sun Microsystems claimed that its httpd (web server) was on board, and the configuration of the product could be achieved through any web client (http client).

Summary of the Invention

One embodiment of the invention involves remote controller firmware for providing httpd service (Web server), and another, the use of infra-red and/or electromagnetic transmission with the controller.

According to another embodiment the remote

controller providing httpd service is in the form of a firmware device containing a microcomputer with a network interface, electronic interface, and infra-red interface. This firmware device receives http requests from http clients (web browsers) and replies with html (Hypertext Markup Language) documents. Within these html documents are buttons, text input boxes, and other graphical user interface (GUI) elements that the user employs to manipulate on the http client screen to make things happen remotely. The remote controller controls and monitors remote devices such as TVs, air conditioners, and VCRs.

Other embodiments, objects, and advantages of the invention will become evident from the following detailed description of preferred embodiments of the invention when read in light of the following drawings.

Brief Description of the Drawings

Figure 4 is a flow diagram illustrating the software flow of an embodiment of the invention.

Figure 5 is a flow diagram illustrating the software flow of an embodiment of the invention.

Figure 6 is block diagram of another embodiment.

Figure 7 is a flow diagram illustrating the software flow of an embodiment of the invention.

Figure 8 is a schematic block diagram illustrating an embodiment of the invention.

Detailed Description of Preferred Embodiments

In Figure 1 an ethernet network connection NC1 connects a user computer UC1 to a controller CO1 composed of firmware FI1 having electronic, electromagnetic, and/or infrared interfaces SI1. The latter connect the firmware FI1 to a number of targets TA1 in the form of appliances/equipments. Targets TA1 are for example VCRs, TVs, and/or air conditioners. The controller CO1 with its firmware FI1 and the targets TA1 may be at locations remote from the computer CO1. The network connection NC1 may include a commercial telephone utility.

Within the user computer UC1, a WWW browser WB1 includes GUI (graphical user interface) elements generally designated GE1 such as buttons BU1, a textbox TE1, and menus ME1 to affect the target.

Figure 2 is a block diagram illustrating details of the firmware FI1 of Figure 1. Here, a bus BU1 transfers signals to and from a central processing unit CPU CP1, a memory ME1, a non-volatile Flash RAM FL1 and a real time clock CL1. The CPU CP1 is connected to the network connection NC1 via an Ethernet interface EI1, and to remote control via serial interfaces SI1.

Figure 3 is a flow chart illustrating the flow of steps and the location of the performance of

each step. Steps 104, 110, and 130 take place in the WWW browser WB1. Steps 107, 114, 117, 120, 124, and 127 take place in the firmware FI1 of the controller CO1. In step 104 the user accesses the URL (universal resource locator). In step 107 an html (HyperText Markup Language) page is served. Step 110 is the user input to the WWW browser. Step 114 involves invocation of the internal firmware program. This includes steps 117, step 120, and step 124. In step 117 the program effects remote command transmission. In step 120 the firmware collects remote information, and in step 124 cues future program execution. In step 127 request is acknowledged and the execution result sent. In step 130, the results are displayed in the web browser.

With respect to the firmware FI1 of the controller CO1: (1) an httpd resides on the physically separate controller apart from the targets and operates itself; (2) an httpd code permanently resides in the firmware; (3) html pages are uploadable; (4) the firmware is intended for control and monitoring, not setup and configuration; (5) the firmware has interface ports (electronic, electromagnetic, and infra-red) dedicated to control other devices. According to an embodiment the controller CO1 controls multiple devices at the same time.

The controller CO1 has an interface in the form of a modem and/or an ISDN interface to provide the capability of operating over the public network.

According to an embodiment, fast electronic

serial ports on the controller CO1 send and receive digitally encoded voices and pictures to establish virtual phones, fax machines, and telephone answering machines over the Internet. That is, when someone interacts with the graphical element on the html served by the controller CO1, it can make a connection through the fast serial ports to a digital telephone; when someone transfers digitally encoded graphical information to the httpd (Web server), the controller can send received pictures to the printer through the fast serial interface.

The invention involves use of infra-red or/and electromagnetic transmission with the controller CO1. The controller has an infra-red or/and electromagnetic transmitter/receivers to communicate with other devices in the proximity. Upon the receipt of the command from http clients (web browser), the controller sends infra-red or electromagnetic signals to the targets TA1. According to embodiments the targets, like VCRs, TVs, or air conditioners, also reply or send status information back to the controller CO1 to be received.

The controller comes with several default html pages to control popular devices like a TV. However, the system is arranged so the end user can upload his/her own html documents over the network to the controller CO1 to have a custom controlling environment. It is also possible to upload programs to the controller to act on the status information from the controlled devices targets.

The application of the controller CO1 is extensive. In one embodiment it controls household appliances like a VCR, TV or air conditioner. In another embodiment it controls and monitors devices in remote sensing stations. In another embodiment it controls and monitors security systems for houses. In another embodiment it controls and monitors equipment on a factory floor. In another embodiment it controls and monitors greenhouses or aquariums in remote locations. In another embodiment it controls and monitors copy machines, faxes, and other equipment in offices. In another embodiment the controller CO1 acts as a virtual telephone, fax, and telephone answering machine on the Internet.

According to an embodiment the controller CO1 constitutes a stand-alone world wide web server (httpd) for Ethernet networks in the form of a "firmware" web server which is easy to use and fully programmable. It is a firmware-based World Wide Web Server. According to an embodiment, the controller CO1 is a stand-alone unit which contains a high-speed microprocessor in the CPU CP1, the Ethernet interface EI1 and the Flash RAM FL1 on a single board. This combination makes it plug-and-play ready as well as easy-to-program for customized Internet environments. Unlike traditional Web servers which include a hard drive, monitor and keyboard, the invention processes data through streamlined firmware which is much less expensive to manufacture. This allows one to incorporate the same advanced features for establishing, maintaining and updating a website at a low price. According to an

embodiment, the controller CO1 forms a unit which includes a built-in LCD display panel.

The controller CO1 is suitable for corporate applications and service providers. It permits easy operation, and in an embodiment is simple to set up and install. Users merely connect the unit to the Ethernet hub, set an IP address/netmask on the product's built-in LCD panel and the unit is configured to serve Web pages to a network. The controller requires that the network be equipped with a router to provide Internet access through high-speed TI, ISDN or dedicated lines.

System software is updated quickly and easily via the Internet by clicking on the appropriate hot button on the system administration web page, served by the controller. The controller downloads the appropriate updates from the Internet host.

According to an embodiment the controller CO1, in its firmware FI1, includes a Tcl interpreter which allows programmers to customize the server for many uses. The invention is fully programmable through a built-in Tcl interpreter in ROM. According to an embodiment the server (httpd) itself is based on Tcl and uses Tcl as its source code. According to an embodiment the httpd is modified and expanded to meet the demands of volume users such as VARs and Internet service providers. According to an embodiment, the controller comes with password support, Common Gateway Interface (CGI) scripts for Web page authoring, text/binary file downloading and file system

manipulation. Note Pad groupware application and Simple Mail Transfer Protocol (smstp) source codes are included as sample Tcl CGI scripts.

According to an embodiment, the controller furnishes a tamper proof hardware firewall for network security. The controller allows the unit to be placed outside of the hardware firewall to serve as a stand-alone Web server and to ensure security of a company network. According to an embodiment the user sets a hardware switch to make the Flash RAM read-only.

Fig. 4 illustrates another embodiment in the form of a flow chart showing the flow of steps and the location of the performance of each step. Steps 404, 410, and 420 take place in the WWW Browser WB1. Steps 407, 414, and 417 take place in the firmware FI1. In this embodiment, a telephone company has a BBS (bulletin board system) listing all telephone numbers and addresses throughout the country or a region. A licensed user who wishes to publish a local phone book, or an individual who wishes to update a personal telephone book, uses a URL (Universal Resource Locator) to request the phone book from the firmware in the controller CO1 in step 404. In effect the user is asking the firmware FI1 in the controller to retrieve the number through the web pages. In step 407, the firmware FI1 returns a form with input boxes and a pull down menu. Consequently, in steps 410, the user enters the name of the person or company whose telephone number he wishes to acquire. In step 414, the firmware FI1 initiates communication with the BBS. In step 417,

the firmware FI1 creates a page with data retrieved from the communication. In step 420 the user views the results and determines whether it should be placed in the local or personal directory.

The integrated local phone book program keeps the queried phone numbers, so that the same query does not initiate another transaction to hone company BBS. The user can click on the entries on the local phone book to have the controller frimware initiate the phone call by using the modem, or have the controller CO1 communicate through serial port to PBX to have the call placed for the user.

According to an embodiment anyone in an office (intranet) can access the controller firmware to get the phone number and also can look for new numbers with this new feature.

The controller strategy in the way that is base on a firmware based server and programs are preinstalled.

According to an embodiment, the controller CO1 periodically polls daily TV program listing from a central server (e.g. TV station web pages) using HTTP protocol. The controller CO1 is acting as a web client at this time. Alternatively, the controller utilizes data broadcasting service to receive TV listing to be used in the operation. The controller CO1 processes the received TV listing and creates a web page with buttons and pull down menus to facilitate the user

interface. Using this web page served by the controller CO1, the user can turn on TV, select channel on the TV, operate VCR, and program VCR (video cassette recorder) to record the future TV programs. As an option, the controller CO1 stores the TV selection/VCR programming data on the flash memory to be delivered or polled to/from TV ratings services. This arrangement appears in the flow chart of Figure 5.

In Fig. 5 the flow chart is divided into 4 columns, namely user, controller, TV listing websites, TV/VCR. Each step is placed in the column in which the step occurs.

Steps 514 and 520 occur in the users web browsers WB1. Steps 504, 510, 517, and 524 take place in the controller CO1. Steps 507 and 524 take place in a TV listing website. Step 529 takes place in the TV/VCR.

In step 504 the controller CO1 periodically polls the daily TV program listing from a central server, namely TV listing websites or pages. In step 507 the TV listing websites serve the TV listing to the controller CO1. The controller CO1, in step 510 process and stores the listings. In step 514, the user uses the web browser WB1 to access the TV listing URL (universal resource locator) of the controller CO1. The controller serves the TV listing page, in steps 517, with controls. In step 520 the user clicks on the program listing to operate the TV or VCR. And passes this information to the controller CO1. In step 524

the controller transmits an inferred signal to operate the TV/VCR now or later according to user preference. In step 527 the TV/VCR shows channel or program.

Fig. 6 illustrates another embodiment of the system shown in Fig. 1. Here, one of the target appliances is a global positioning system (GPS) receiver. The GPS receiver may be on a moving vehicle or ship either in communication with the controller or the entire controller CO1 with the GPS receiver may be on a moving vehicle.

The operation of the GPS receiver with the controller and the user computer appears in Fig. 7. Here, the steps are placed in columns representing the location of where the steps take place. In step 704, the GPS receiver GP1 receives data and transmits the data to the controller via a serial port. In steps 607, the controller processes, summarizes and stores the data in a DRAM or flash memory ME1. The user computer UC1 queries the GPS data in step 610, and in step 614, the frimware on the controller CO1 returns the data. The controller receives the updated GPS data every second from the GPS receiver connected through the serial port. The controller CO1 processes, summarizes, and stores the data in the memory ME1. The computer UC1 controls numerous controllers CO1 synchronously to receive the data through TCP/IP (transmission control protocol/internet protocol) connections. Using the data in the centralized system, one obtains very accurate geographical data from the GPS system. Fig. 8 illustrate a system where a number

of controllers CO1 connect to the user computer UC1.

The controller CO1 constitutes a firmware based www server. The CPU may for example be a high speed microporcessor.

While embodiments of the invention have been described in detail, it will be evident that the invention may be embodied otherwise without departing from its spirit and scope.

What is claimed is:

1. Apparatus for control of remote devices, comprising:

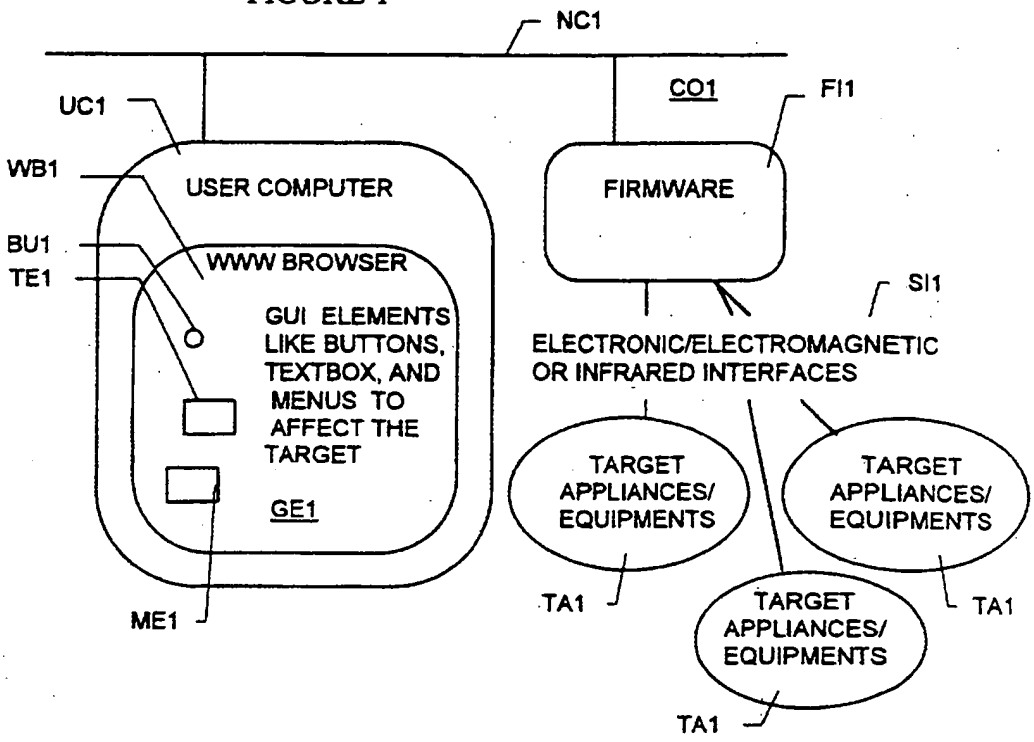
a computer;

an ethernet network coupled to said computer;

a remote controller firmware providing httpd service coupled to said network; and

infra-red and/or electromagnetic transmission coupling the controller firmware with the devices.

FIGURE 1



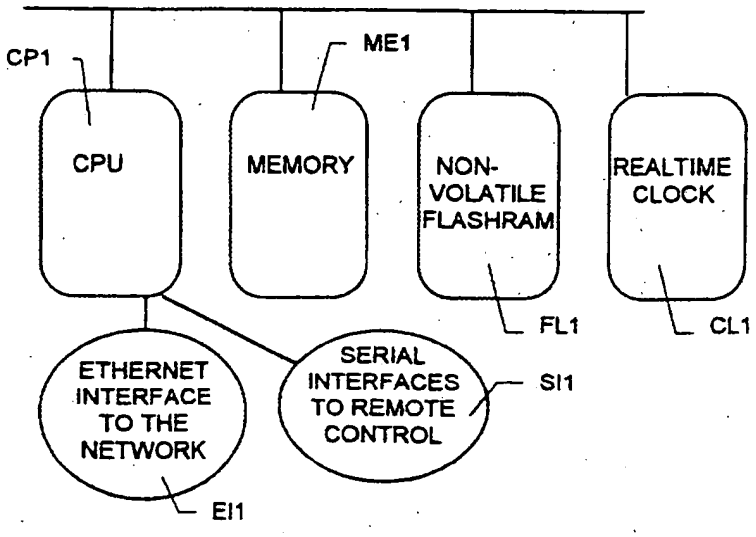


FIGURE 2

FIGURE 3

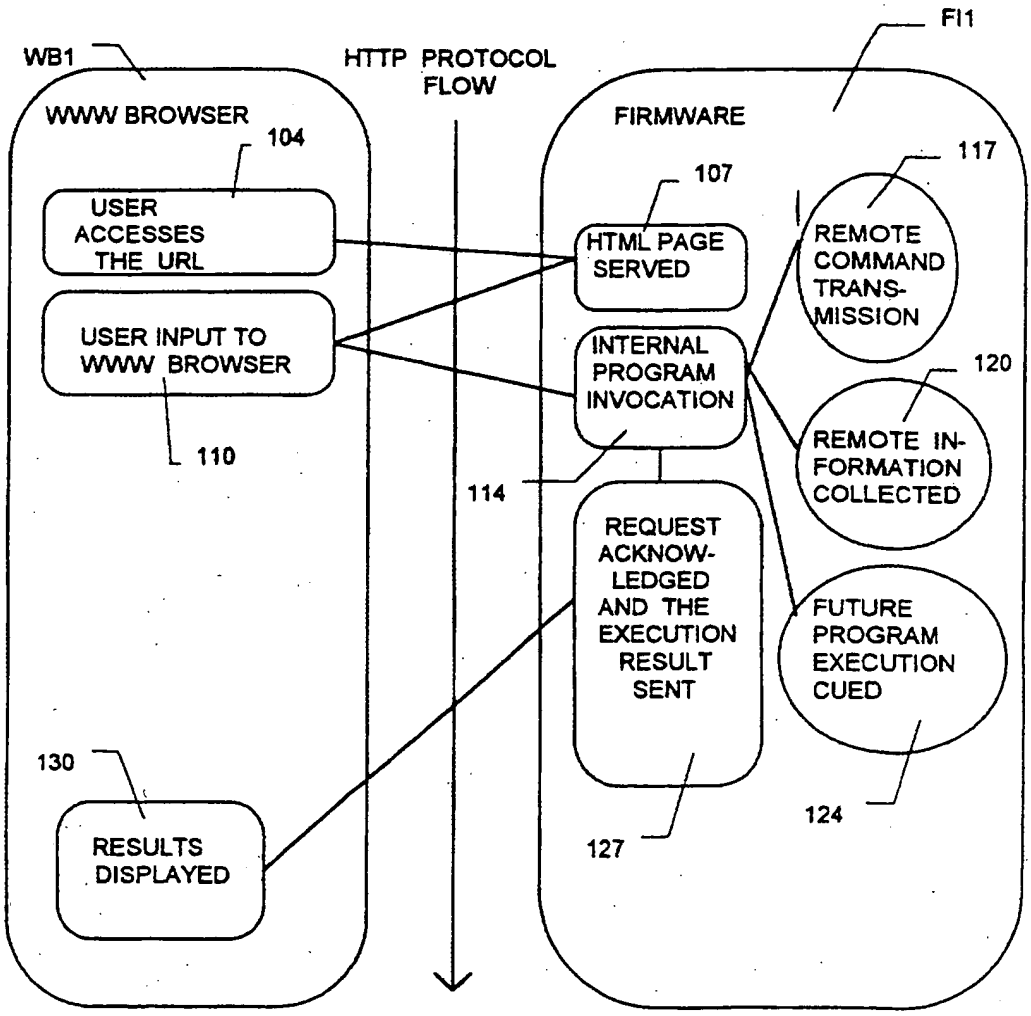

WB1
WWW BROWSER
104
USER ACCESSES THE URL
USER INPUT TO WWW BROWSER
110
130
RESULTS DISPLAYED
HTTP PROTOCOL FLOW
FI1
FIRMWARE
107
HTML PAGE SERVED
INTERNAL PROGRAM INVOCATION
114
REQUEST ACKNOW-LEDGED AND THE EXECUTION RESULT SENT
127
117
REMOTE COMMAND TRANS-MISSION
120
REMOTE IN-FORMATION COLLECTED
FUTURE PROGRAM EXECUTION CUED
124

FIGURE 4

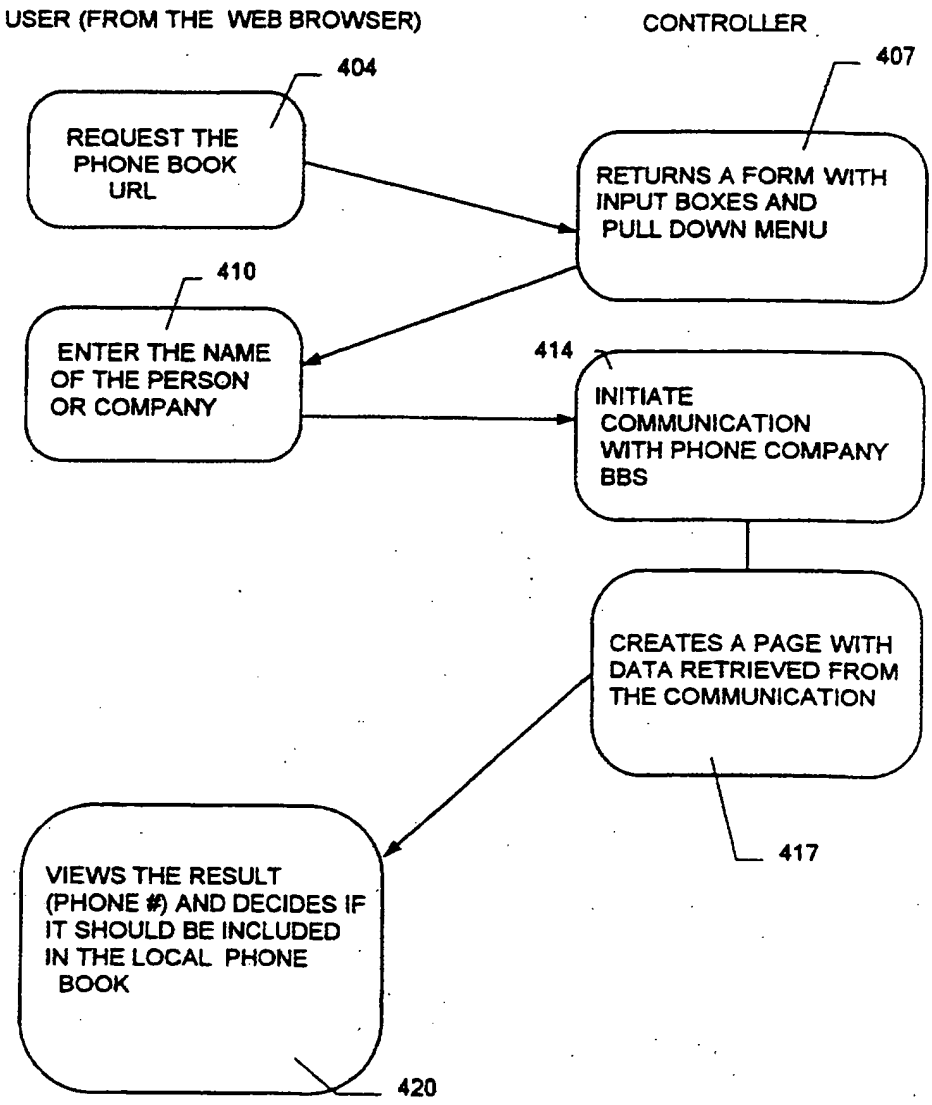

USER (FROM THE WEB BROWSER)
CONTROLLER
404
REQUEST THE PHONE BOOK URL
407
RETURNS A FORM WITH INPUT BOXES AND PULL DOWN MENU
410
ENTER THE NAME OF THE PERSON OR COMPANY
414
INITIATE COMMUNICATION WITH PHONE COMPANY BBS
CREATES A PAGE WITH DATA RETRIEVED FROM THE COMMUNICATION
417
VIEWS THE RESULT (PHONE #) AND DECIDES IF IT SHOULD BE INCLUDED IN THE LOCAL PHONE BOOK
420

FIGURE 5

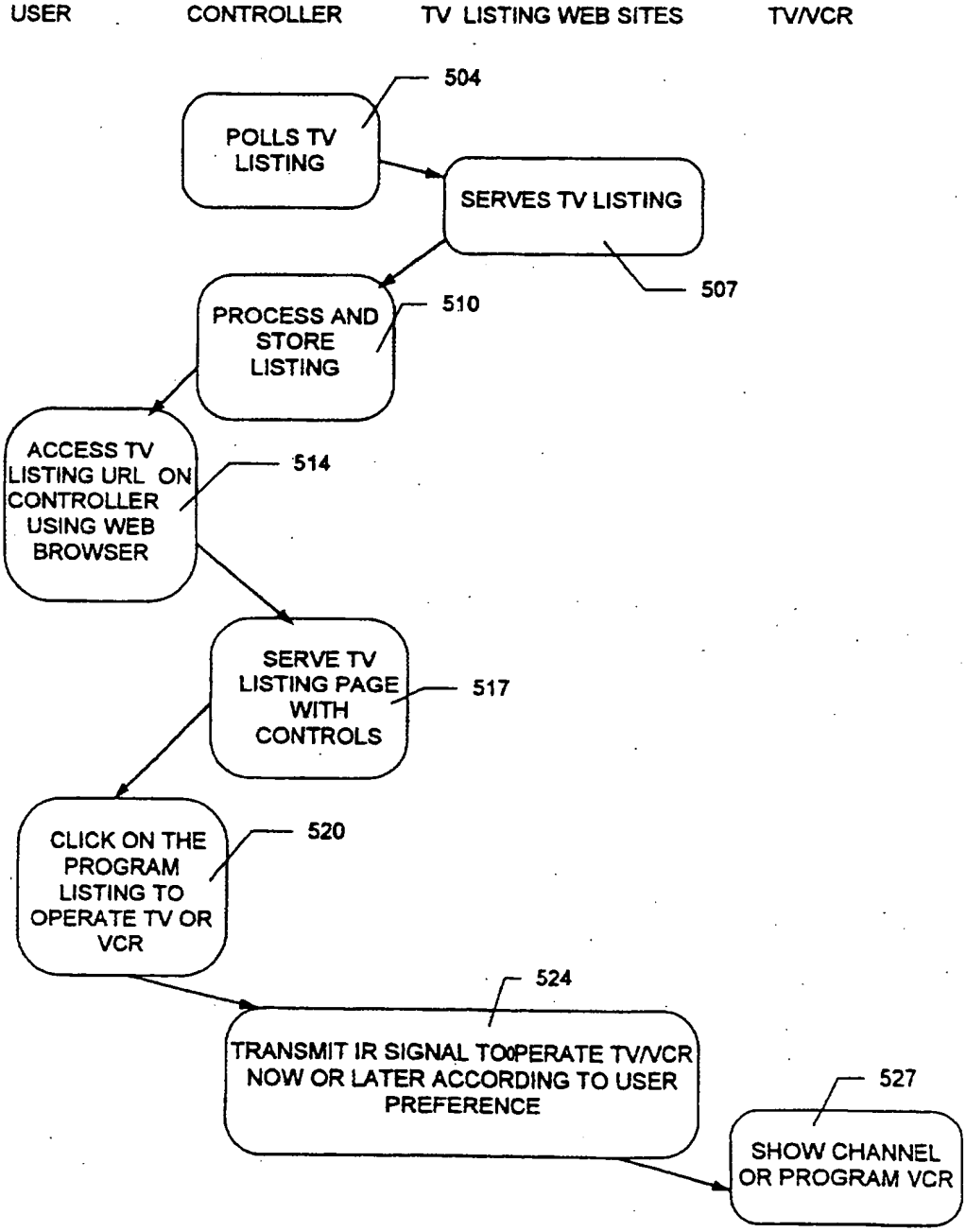

USER
CONTROLLER
TV LISTING WEB SITES
TV/VCR
504
POLLS TV LISTING
SERVES TV LISTING
507
PROCESS AND STORE LISTING
510
ACCESS TV LISTING URL ON CONTROLLER USING WEB BROWSER
514
SERVE TV LISTING PAGE WITH CONTROLS
517
CLICK ON THE PROGRAM LISTING TO OPERATE TV OR VCR
520
524
TRANSMIT IR SIGNAL TOOPERATE TV/VCR NOW OR LATER ACCORDING TO USER PREFERENCE
527
SHOW CHANNEL OR PROGRAM VCR

FIGURE 6

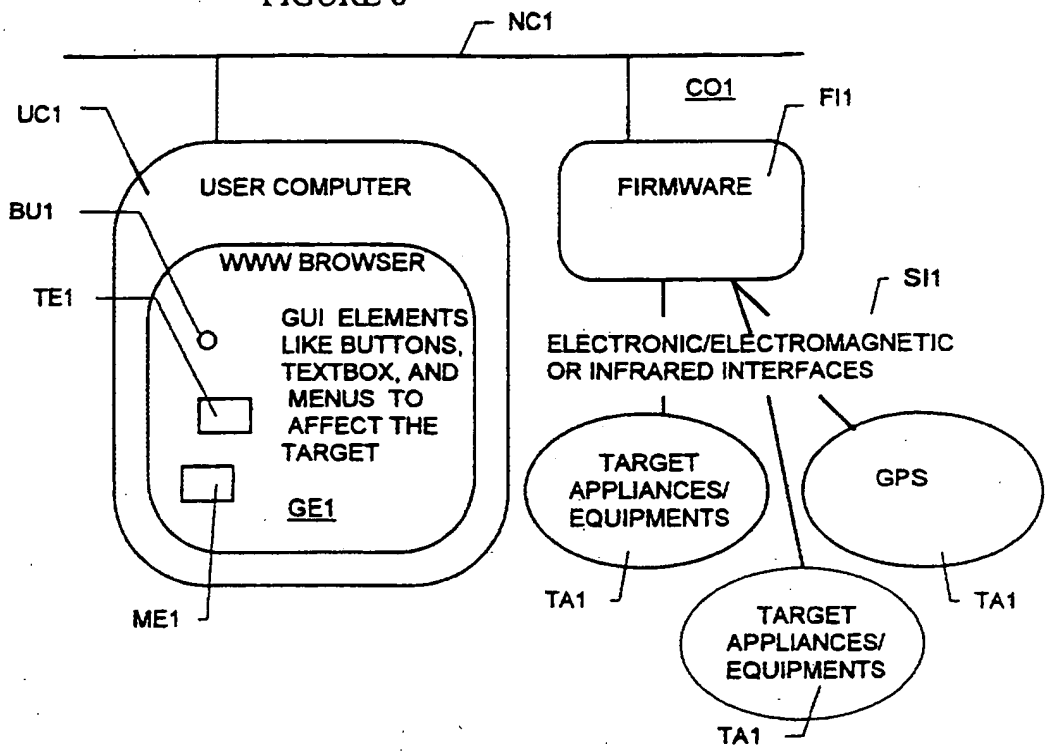

NC1
CO1
FI1
UC1
USER COMPUTER
FIRMWARE
BU1
WWW BROWSER
SI1
TE1
GUI ELEMENTS LIKE BUTTONS, TEXTBOX, AND MENUS TO AFFECT THE TARGET
ELECTRONIC/ELECTROMAGNETIC OR INFRARED INTERFACES
TARGET APPLIANCES/ EQUIPMENTS
GPS
GE1
ME1
TA1
TA1
TARGET APPLIANCES/ EQUIPMENTS
TA1

FIGURE 7

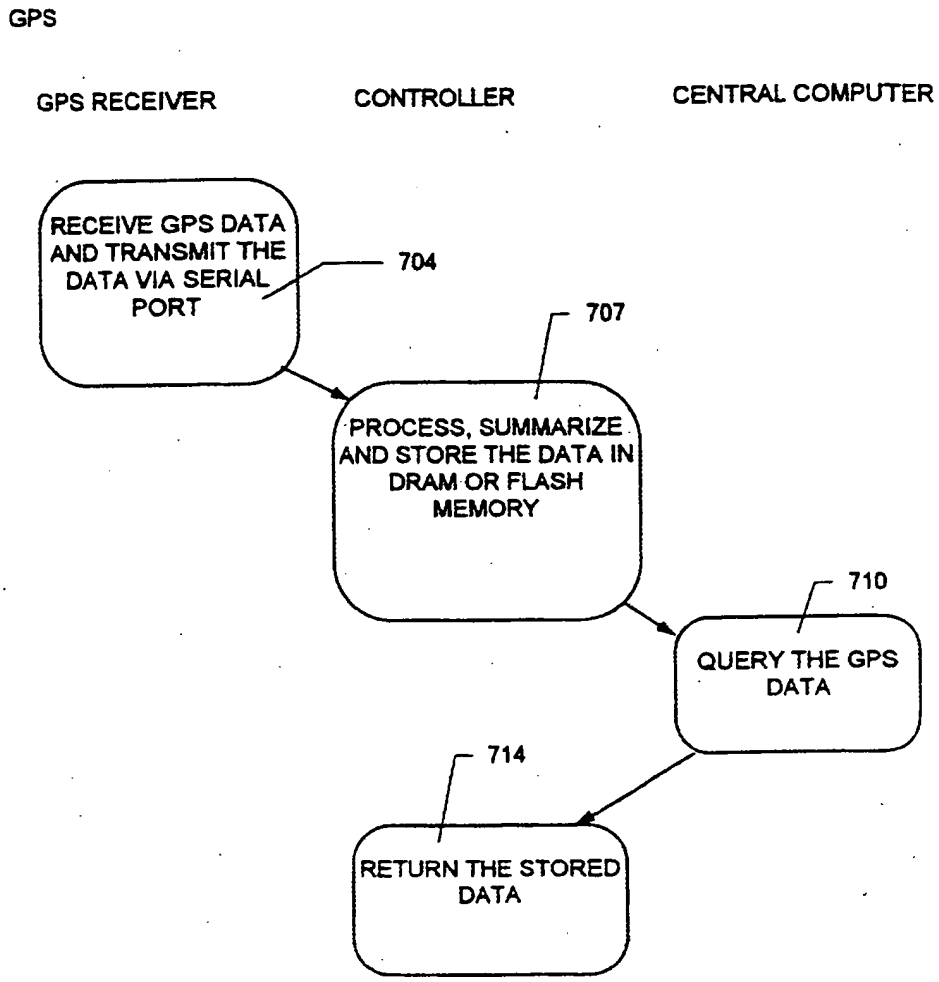
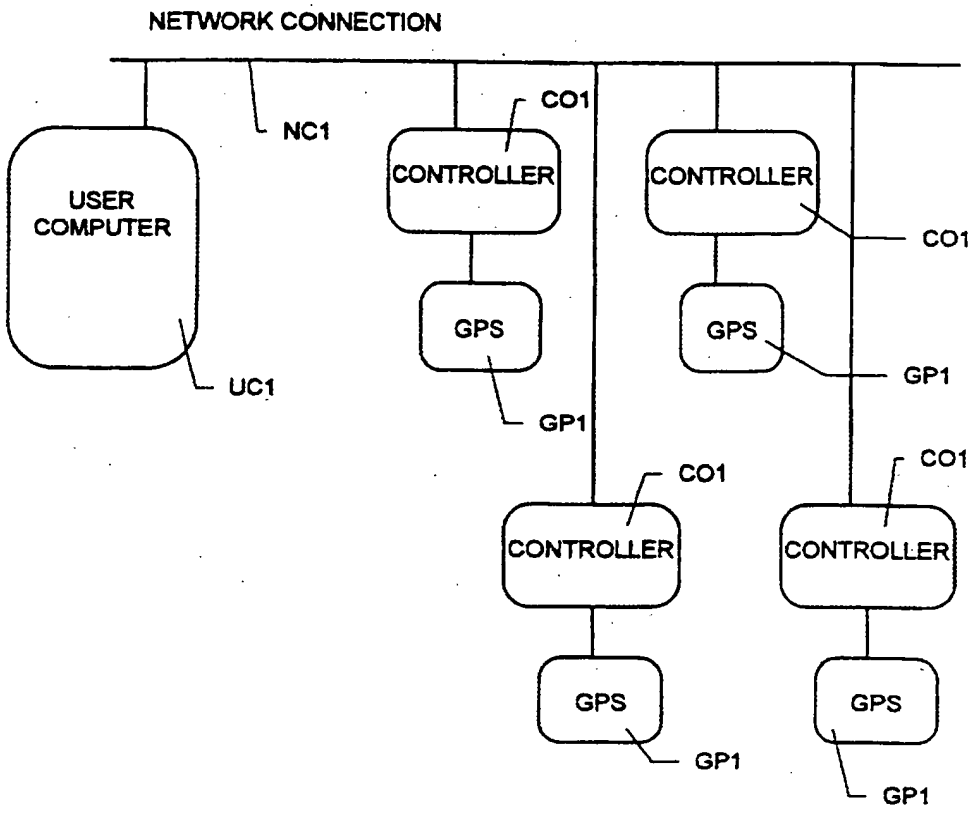

GPS
GPS RECEIVER
CONTROLLER
CENTRAL COMPUTER
RECEIVE GPS DATA AND TRANSMIT THE DATA VIA SERIAL PORT
704
707
PROCESS, SUMMARIZE AND STORE THE DATA IN DRAM OR FLASH MEMORY
710
QUERY THE GPS DATA
714
RETURN THE STORED DATA

FIGURE 8


NETWORK CONNECTION
NC1
CO1
CONTROLLER
CONTROLLER
CO1
USER COMPUTER
UC1
GPS
GPS
GP1
GP1
CO1
CO1
CONTROLLER
CONTROLLER
GPS
GPS
GP1
GP1

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